4.3 WATER RESOURCES

4.3.1 Introduction

This section describes potential impacts to water resources associated with the construction and operation of the proposed Project and connected actions and discusses potential mitigation measures that would avoid or minimize the potential impacts. The information, data, methods, and/or analyses used in this discussion are based on information provided in the 2011 Final Environmental Impact Statement (Final EIS) as well as new circumstances or information relevant to environmental concerns that have become available since the publication of the Final EIS, including the proposed major reroute in Nebraska and numerous minor (less than one mile) reroutes in Montana and South Dakota. The information that is provided here builds on the information provided in the Final EIS and in many instances replicates that information with relatively minor changes and updates. Other information is entirely new or substantially altered from that presented in the Final EIS. Specifically, the following items have been substantially updated from the 2011 document related to impacts to water resources:

- A new section, Section 4.3.2 “Impact Assessment Methodology” was added to explain the assessment methodology used to evaluate potential water resources impacts associated with the proposed Project.
- Additional water resource datasets for both ground and surface water were used in South Dakota and Montana to supplement previous information to allow for a more detailed and accurate assessment of impacts to this resource;
- Ground and surface water data were collected and analyzed for the major new proposed routing in Nebraska in order to address water quality, flow, usage, and availability;
- The impacts of releases to ground water were assessed and included anticipated release assessment, response, and mitigation measures;
- Recommended proposed pipeline inspections and testing steps were developed that would supplement Keystone’s process and procedures;
- Potential winter deicing impacts and criteria for mitigation were assessed;
- The activities and impacts associated with acquiring water from surface or ground water sources were assessed;
- The number and type of stream crossings and stream crossing methods have changed due to changes in the proposed Project route as well as updated field survey information provided by Keystone. The stream crossing assessment was comprised of a desktop analysis based on National Hydrologic Dataset (NHD) information and supplemented by Keystone field survey descriptions;
- Based on the limitations of the data used in the desktop analysis, the intermittent and ephemeral stream categories were combined and assessed as intermittent streams. Mitigation measures and construction best management practices (BMPs) were applied consistently to both stream types throughout this section;

- Surface water bodies which may be considered for potential hydrostatic test water sources along the proposed Project route were listed as provided by Keystone. Probable limitations on water withdrawal in over allocated basins were discussed; and
- Ancillary facilities with known locations that intersect state and federally designated or mapped floodplain areas or in some instances effective floodplain areas in Montana, South Dakota, and Nebraska were identified;
- Section 4.3.4 "Recommended Additional Mitigation" provides a list of additional mitigation measures to further reduce impacts to water resources.

Further discussion of impacts and potential mitigation measures related to potential petroleum releases from pipeline operation is provided in Section 4.13, Potential Releases.

4.3.2 Impact Assessment Methodology

4.3.2.1 Groundwater

The impacts of the proposed Project on groundwater quality may potentially occur as a result of two main categories of petroleum product releases: those from construction-related activities and those from operation-related activities. Note that the responses to releases to groundwater will be similar for the two categories, and will be scaled as appropriate based on the magnitude of the specific release. The volume of different petroleum release scenarios is based on the same volumetric divisions included in the spill impact assessment discussion in Section 4.13, Potential Releases. Potential releases from construction-related activities would be expected to be small (less than 2,100 gallons) to medium (2,100 gallons to 42,000 gallons) releases of refined petroleum products, such as motor fuel or lubricating oils, from vehicles or from bulk storage areas related to vehicle refueling and maintenance activities. Potential releases related to proposed Project operation also include these types of impacts, in addition to including releases of crude oil ranging from small (less than 2,100 gallons) to large (42,000 gallons to 840,000 gallons), which are the established release ranges evaluated in Section 4.13, Potential Releases. Note that the maximum planned storage capacity of refined petroleum products (motor fuels) on the Project during construction activities is 12,000 gallons.

Although refined petroleum products (e.g., gasoline, diesel, heating oil), as compared to crude oil, typically travel more readily in soils and groundwater due to their typically lower viscosity and higher soluble fractions, the general impacts from releases of both types of materials retain enough similarity that the effects of each will be discussed in a single narrative below. The relatively small scale of potential refined petroleum product releases related to the proposed Project also limits the utility of evaluating releases of refined products and crude oil separately within the scope of this document. Information from releases of both crude oil and refined petroleum products are included in the discussion of groundwater impact assessment.

As discussed in Section 4.13.3.4; Potential Releases, Spill Impact Assessment, Types of Spill Impact; most crude oils are more than 95 percent carbon and hydrogen, with small amounts of sulfur, nitrogen, oxygen, and traces of other elements. Crude oils contain lightweight straight-chained alkanes (e.g., hexane, heptane); cycloalkanes (e.g., cyclohexane); aromatics (e.g., benzene, toluene); cycloalkanes; and heavy aromatic hydrocarbons (e.g., polycyclic aromatic hydrocarbons, asphaltines). Straight-chained alkanes are more easily degraded in the environment than branched alkanes. Cycloalkanes are extremely resistant to biodegradation.

Aromatics (i.e., benzene, toluene, ethylbenzene, and xylene [BTEX] compounds) pose the most potential for toxic impacts because of their lower molecular weight, making them more soluble in water than alkanes and cycloalkanes. Refined petroleum products typically have variable concentrations of these more soluble compounds, with lighter fuel products such as gasoline containing as much as 35percent or greater BTEX, and heavier distillates used as lubricating oils having no significant BTEX fraction. In general, the higher the concentration of BTEX in the petroleum material, the greater the risk to groundwater quality related to a release of the material.

To evaluate the potential impacts to groundwater resources, regional aquifer information and well locations within 1 mile of the proposed Project were superimposed on the proposed pipeline route using Geographic Information System (GIS) software. Results of the evaluation of water resources and water use in the proposed Project area are included in Section 3.3.2; Water Resources, Groundwater. The potential impacts to groundwater resources from both construction and operation impacts from the proposed Project are discussed in Section 4.3.3.1, Groundwater. Medium to large spills would typically require greater than 3 years to attenuate or remediate, and, therefore, would be considered a long-term impact.

Additional groundwater-related impacts may also be related to increased local extraction of groundwater during construction and pipeline testing activities. Additional Project-related groundwater use, although temporary, would remove water from aquifers and could potentially decrease groundwater levels in extraction wells, depending on aquifer recharge characteristics.

4.3.2.2 Surface Water

The impacts of the proposed Project on surface water resources are separated into two categories: construction impacts and operations impacts. In many cases, potential impacts overlap between construction and operations. The impact assessment takes into account potential impacts to surface water resources by categorizing them into duration (temporary, short-term, long-term, and permanent) and describing mitigation measures to reduce or minimize impacts. Durations are described as follows:

- Temporary impacts would generally occur during construction, with the resources returning to preconstruction conditions almost immediately afterward;
- Short-term impacts would continue for approximately 3 years following construction;
- Long-term impacts would require more than 3 years to recover; and
- Permanent impacts would occur as a result of activities that modify resources to the extent that they would not return to preconstruction conditions during the life of the proposed Project.

In addition, the impact assessment calculated several different metrics and performed additional evaluations for surface waterbodies, including the following:

- Calculated the number of waterbodies and waterbody types crossed by the proposed pipeline route;
- Evaluated water quality classifications and impairments for the waterbodies crossed by the proposed pipeline route;
- Evaluated surface water supply sources within 1 mile of the proposed pipeline centerline;

- Calculated the number of mapped floodplains and the total width of mapped floodplains crossed by the proposed pipeline route; and
- Evaluated the same types of surface water resources and waterbody attributes (such as water quality classifications and impairments) impacted by proposed ancillary features such as access roads, pads, and work areas.

4.3.3 Potential Impacts

4.3.3.1 Groundwater

The impacts of the proposed Project on groundwater may potentially occur as a result of construction-related activities and operation-related activities. The volume of different petroleum release scenarios is based on the same volumetric divisions included in the spill impact assessment discussion in Section 4.13, Potential Releases. Potential small (less than 2,100 gallons) releases of petroleum products that could impact groundwater quality would be related to spills or leaks of refined petroleum products from equipment and vehicles. Small (less than 2,100 gallons) to medium (2,100 gallons to 42,000 gallons) refined petroleum product spills may also occur from tanks in material staging areas supporting equipment operation during the construction and operation phases. Medium to large (42,000 gallons to 840,000 gallons) spills of crude oil may occur during the proposed Project operation. Any petroleum releases from construction or operation could potentially impact groundwater where the overlying soils are permeable and the depth to groundwater is shallow. The factors influencing subsurface migration of a crude oil release that reaches groundwater are discussed in the following subsection.

There is potential for spills and releases from equipment maintenance areas, camps, horizontal directional drilling (HDD) locations, and pipeline placement areas. The size of those spills and releases would generally be small (< 5,000 gallons), as most equipment would be fueled by a tanker that would be staffed during operations. The Construction, Mitigation, and Reclamation Plan (CMRP) addresses actions to prevent spills and releases, and emergency response plans will be developed and training conducted, thereby reducing the potential impact to ground or surface water quality.

Keystone would conduct baseline water quality testing for domestic and livestock water wells within 300 feet of the centerline of the approved route, upon the request of individual landowners who provide access to perform the testing. These baseline samples would be collected prior to placing the pipeline in service. In the event of a significant spill, Keystone would conduct water well testing as required by the relevant regulation governing the location where the spill occurs. Keystone would also provide an alternate water supply for any well where water quality was found to be compromised by a spill.

Subsequent subsections present potential impacts to the aquifers beneath the proposed pipeline area resulting from the proposed Project construction and/or operation. Mitigation measures that would be put in place to avoid, minimize, and mitigate releases from pipeline operation are discussed in Section 4.13, Potential Releases.

Factors Affecting Subsurface Petroleum Migration and Groundwater Flow

The potential for, and dynamics of, crude oil or refined oil products migrating into groundwater, and subsequent fate and transport[1] in the groundwater as light non-aqueous phase liquid (LNAPL)[2] or as a dissolved-phase plume,[3] is determined by the several factors, including:

- The volume and areal extent of the petroleum release;
- The viscosity and density of the petroleum release;
- The permeability of unsaturated soils and aquifer characteristics within the area of the petroleum release;
- The depth to first groundwater; and
- Horizontal and vertical groundwater gradient and aquifer hydraulic conductivity including surface water and groundwater interconnections.

Release Volume and Extent

The volume and extent of a petroleum release typically affects whether or not the release will affect groundwater quality, and to what degree groundwater quality will be affected. Petroleum released to soils at the ground surface or in the subsurface will be absorbed to soil particles, which will limit the migration of the petroleum material downward to groundwater. In order for LNAPL to reach groundwater, the release must be large enough to overcome the natural absorption capacity of the soil through which it migrates. The measure of the maximum amount of petroleum material that a soil can absorb and immobilize is known as residual saturation. Typical petroleum residual saturation rates in clean sands range from approximately 5,833 milligrams of petroleum per kilogram of soil for light petroleum products, such as gasoline, to 20,382 to 42,618 milligrams per kilogram of soil for more viscous petroleum products, such as mineral oil (Brost and DeVaull 2000). Residual saturation rates for petroleum products typically increase as soil grain size decreases and viscosity of the petroleum product increases; higher residual saturation rates result in more contaminant mass immobilized within the soil.

Studies related to petroleum product releases from over 600 underground storage tank (UST) leaks indicate that potential surface and groundwater impacts from these releases are typically limited to the area within several hundred feet of the release site (American Petroleum Institute [API] 1998). The median length of groundwater plumes composed of soluble petroleum components (benzene, toluene, ethylbenzene, and xylenes) from these UST sites was 132 feet, and approximately 75 percent of these plumes were under 200 feet (API 1998). Although the petroleum products and release conditions at a crude oil pipeline are somewhat dissimilar from those at a typical UST, the contaminant distribution conditions in groundwater observed at UST sites would correlate to conditions expected from small to medium releases related to the proposed Project, especially for the potential releases of refined petroleum products associated

[1] Fate and transport: A term alluding to the manner in which a contaminant moves through an aquifer in groundwater, and how concentrations in groundwater are ultimately reduced over time and/or distance.
[2] Light non –aqueous phase liquid: A liquid that does not contain water (e.g., gasoline) that has a lower density than water, and will therefore float on a water surface.
[3] Dissolved-phase plume: The portion of a released material that becomes dissolved in groundwater and moves along the direction of groundwater flow.

with construction and maintenance activities and for smaller potential releases from pipeline operations.

As detailed in Section 4.13 Potential Releases, releases of different volumetric scales (small, medium, and large) of crude oil from the proposed Project were modeled to evaluate the expected extent of the dissolved-phase petroleum hydrocarbon plume in groundwater that would be expected to be associated with those releases. The release modeling assumed a sandy aquifer similar to many of the alluvial aquifers and of the Tertiary Northern Great Plains Aquifer System (NGPAS) and Northern High Plains Aquifer (NHPAQ) groups present along the proposed Project route. The model outputs indicate that releases of crude oil from the proposed Project ranging from small (2,100-gallon) to large (840,000 gallon) would result in axial lengths of the dissolved-phase petroleum hydrocarbon plumes ranging from 640 to 1,443 feet, respectively.

To further assess groundwater impacts related to a large-scale crude oil release into a coarse-grained, shallow, unconfined aquifer, studies of a 1979 pipeline release near Bemidji, Minnesota, were reviewed. Approximately 449,400 gallons (10,700 barrels) of crude oil were released onto a glacial outwash (alluvial) deposit consisting primarily of sand and gravel. The water table in the spill area ranged from near ground surface to approximately 35 feet below ground surface (bgs). As of 1996, the leading edge of the subsurface LNAPL plume had migrated approximately 131 feet downgradient from the spill site, and the leading edge of the dissolved contaminant plume had migrated approximately 650 feet downgradient from the spill site.

These studies of the UST sites and the Bemidji release, and the results of the petroleum release modeling completed as part of this study (Section 4.13, Potential Releases), indicate that the size of the oil release is a primary factor influencing the ultimate oil plume dimensions (including the dissolved-phase plume). While there are differences in the rate of oil movement through different soil types, hydrogeologic factors such as hydraulic conductivity and gradient—although important to understanding contaminant migration within an aquifer—are not as significant in determining ultimate plume length (API 1998). Based on a comparison of the UST site releases, the Bemidji release described above, and the release modeling effort completed as part of this study, the petroleum contaminant plume extent in groundwater is not directly proportional to the volume of petroleum product released, and that incremental increases in release volume typically result in incrementally smaller increases in the areal extent of impacted groundwater. For example, under the release model developed as part of this study (Section 4.13, Potential Releases), a release of 2,100 gallons (or 50 barrels) of crude oil resulted in a groundwater contaminant plume a maximum of 820 feet long, while a release of 840,000 gallons (or 20,000 barrels) that is 400 times as large resulted in a maximum plume length of 1,443 feet, or roughly twice as long as the plume related to the smaller release.

Viscosity and Density of Released Material

The dilbit crude oil that would typically be transported by the proposed pipeline would have a viscosity within the range of 52 to 96 centistokes at a temperature of 38 degrees Celsius (viscosity range of diluted bitumen, Imperial Oil 2002), a viscosity similar to that of corn syrup at room temperature. If the oil was released to the surrounding soils and groundwater, it would cool and the viscosity would increase significantly, with a resultant increase in resistance to flow. Viscosity would also increase somewhat under conditions where diluent material used to decrease the crude viscosity can volatilize to the atmosphere. The relatively high viscosity of the crude oil would not only retard the petroleum flow velocity within soil, but would also result in a residual saturation condition in which small crude oil releases would essentially be immobilized as the petroleum cools and viscosity increases.

The high fluid viscosity and resultant resistance to flow in a compacted granular medium (soil) also suggests a higher likelihood that pipeline releases would preferentially migrate under pressure upward through the disturbed soils excavated during pipeline installation and discharge onto the ground surface, with relatively less crude oil infiltrating under gravity deeper into soil toward groundwater.

The crude oil transported within the proposed pipeline is anticipated to have a specific gravity of less than 1 and would be considered an LNAPL. Therefore, potential product releases from the proposed pipeline that migrate to groundwater would preferentially float on the groundwater surface as LNAPL.

Soil and Bedrock Permeability

Permeability of soils and aquifer materials also affects transport of LNAPL and dissolved-phase contaminants from petroleum releases to and within groundwater. Shallow unconfined aquifers are commonly overlain by permeable materials and therefore are at risk if the overlying soils are contaminated.

Many petroleum fractions, including BTEX, are present in bituminous crude oil and associated diluents. These fractions can be transported to groundwater by dissolved-phase[4] transport, either by direct contact of groundwater with LNAPL or by infiltration of precipitation and surface water through petroleum-contaminated soil and into groundwater. Once the dissolved-phase petroleum is in groundwater, the material typically flows within the aquifer at a velocity somewhat less than the groundwater flow, as the dissolved-phase petroleum is subject to absorption to soil particles (in a similar manner as described above regarding migrations through soils above the water table) and degradation by naturally occurring bacteria in the aquifer. The LNAPL typically migrates in the direction of groundwater flow at a rate that varies with product viscosity; more viscous materials (such as heavy crude oil) migrate significantly slower than the groundwater flow.

Downward and, less commonly, horizontal migration of contaminants in unsaturated sediments and within aquifers is commonly attenuated by confining layers or zones of finer-grained, lower permeability sediment. Flow through these units is typically very slow or absent. Confining layers are commonly present between aquifer units, and can also be present within aquifers. For example, the Ogallala Formation of the NHPAQ contains many layers of volcanic ash that are much finer than the aquifer materials above and below them; the ash layers typically function as intra-aquifer confining layers. Additionally, glacial till and silty and clayey layers in alluvial aquifers typically form confining layers in those otherwise coarse-grained units.

Depth to Groundwater

Depth to groundwater would also factor into the travel time of petroleum from the point of release to groundwater. Where groundwater is relatively shallow, contaminants can reach groundwater more quickly than in areas where groundwater is deeper, given similar soil types.

[4] Dissolved-phase plume: The portion of a released material that becomes dissolved in groundwater and moves along the direction of groundwater flow.

Where groundwater is in contact with the proposed pipeline, releases from the pipeline would immediately impact groundwater quality nearest to the release.

Aquifer Gradients and Hydraulic Conductivity

Groundwater flow gradient and hydraulic conductivity of the aquifer materials affect the migration rates of LNAPL and dissolved-phase petroleum products in groundwater. Gradient is a function of potentiometric differential, or, in other words, the tendency of water to flow from areas of higher pressure or elevation to areas of lower pressure or elevation. Hydraulic conductivity is a measure of the ability of the fractured or porous aquifer media to transmit fluid; typically, the smaller the grain size of the aquifer material, the lower the hydraulic conductivity. The groundwater flow velocity in an aquifer is the product of the gradient and the hydraulic conductivity, so the higher the gradient and hydraulic conductivity of an aquifer, the higher the velocity of fluid flow through the aquifer.

As an example, the shallow water-bearing zones in the NHPAQ in eastern Nebraska have an average horizontal flow velocity of about 0.1 foot per day (ft/d) based on an observed gradient of 0.002 (Bleed and Flowerday 1998) and a maximum hydraulic conductivity of 50 ft/d (Gutentag et al. 1984). For the Bemidji release mentioned above, estimates of the aquifer soil hydraulic conductivity ranged from 1.25 to 152 ft/d (Strobel et al. 1998). The hydraulic conductivity reported for the shallow water-bearing zones of the NHPAQ system are within this range.

Vertical flow within and between aquifers is also important to consider when evaluating contaminant migration, and is driven by pressure differentials within and between water-bearing units. For example, vertical groundwater flow between the water-bearing units in the NGPAS within the proposed pipeline area is typically upward, while groundwater flow from the Ogallala Formation is downward in areas where the underlying aquitards (e.g., the Pierre Shale) are absent. Vertical flow velocities are typically at least an order of magnitude less than horizontal flow velocities in aquifer systems.

Aquifer-Specific Contamination Risk Evaluation

Based on the release and migration dynamics of refined petroleum products and crude oil in the subsurface as discussed above, the potential risk and likely magnitude of potential impacts to groundwater quality in each of the aquifers and aquifer groups along the proposed pipeline area in Montana, South Dakota, and Nebraska are evaluated in the following subsections. The final subsection provides an overview of the presence of shallow groundwater in the proposed Project vicinity, as well as water wells reported within one mile of the proposed Project.

Potential groundwater impacts related to the two proposed pump stations in Kansas include releases of refined petroleum products during construction and operation of the pump stations and/or releases of crude oil from the proposed pipeline during Project operation. The extent of groundwater impacts would be dependent on the volume and extent of releases, depth to groundwater, soil characteristics, location of operating water supply wells that would influence hydraulic gradients, aquifer characteristics (e.g., hydraulic conductivity, transmissivity, storativity), and whether the releases reach surface water since groundwater is typically interconnected with surface waterbodies.

Potential groundwater impacts related to construction and operation of the proposed pipe yard in Bowman County, North Dakota would be related to releases of refined petroleum products used as vehicle fuels and lubricants. These releases would typically be relatively small in volume and downward migration of the petroleum compounds through the soil to groundwater would be minimal based on the depth to groundwater and the fine-grained shale and coal intervals of the Fort Union Formation which would tend to slow and/or prevent downward migration. There is a low potential for groundwater impacts depending on the volume and extent of the release. The extent of groundwater impacts for releases that reach groundwater at each of the South Dakota and Kansas locales would be influenced by the same characteristics and parameters discussed in this section.

Alluvial Aquifers and Northern High Plains Aquifer

Alluvial aquifers and the NHPAQ represent the most commonly used sources of groundwater in the proposed pipeline area. Many private and public wells extract groundwater from these aquifers, including those in several Source Water Protection Areas (SWPAs) in the proposed pipeline area. Compared to the other aquifers in the region (Great Plains Aquifer [GPA], Western Interior Plains Aquifer [WIPA], and NGPAS), these aquifers also are typically at highest risk of contamination from the proposed Project construction and operation because of the relatively shallow depth of water tables in the alluvial and NHPAQ aquifers (commonly less than 50 feet) and the relatively high permeability of the aquifers and overlying material. The combination of an extensive groundwater-use profile and high sensitivity to releases from the proposed pipeline area make these aquifers particularly sensitive to potential releases.

No information regarding conditions related to large-scale petroleum releases was readily accessible for the alluvial aquifers or NHPAQ along the proposed pipeline area; however, the crude oil release in Bemidji, Minnesota, previously discussed, occurred in an environment similar to the NHPAQ and alluvial aquifers. At that location, approximately 20 years after the release, the leading edge of the LNAPL oil remaining in the subsurface at the water table had moved approximately 131 feet downgradient from the spill site, and the leading edge of the dissolved contaminant plume had moved about 650 feet downgradient.

Although the subsurface conditions in the NHPAQ or alluvial aquifers as compared to the Bemidji spill site are not identical, the aquifers exhibit similar characteristics that affect groundwater flow and contaminant transport. The Bemidji site provides a reasonable physical model to establish expectations for the behavior of crude oil released in the NHPAQ system and alluvial aquifers. The Bemidji site studies and information from many other petroleum releases in similar conditions suggest that a spill of similar magnitude in the NHPAQ and alluvial aquifer systems would remain localized to a similar extent as the Bemidji plume.

The results of an evaluation of the Bemidji release and other petroleum releases indicate that the dissolved-phase petroleum contaminant plume from a large-scale release that reaches groundwater in the NHPAQ and alluvial aquifers could be expected to affect groundwater quality up to several hundred feet downgradient of the release source. The LNAPL plume, if any, could be expected to affect a significantly smaller distance downgradient of the release. Downward vertical migration may occur, but the lower specific gravity of petroleum material limits the downward migration of contaminants under all but the most robust vertical gradient conditions in aquifers. Even under such conditions in which groundwater flow to deeper aquifers occurs, similar attenuation to contaminant flow would be expected as with the shallower aquifer, and lateral extent of the petroleum contaminants within the deeper aquifer would typically be similar in magnitude to those described for shallow aquifer distribution.

The presence of the high nitrate concentrations common in the shallow groundwater of the NHPAQ and alluvial aquifers in Nebraska may promote degradation of some portion of petroleum mass released into groundwater. Nitrate in groundwater typically encourages biologic degradation of dissolved-phase petroleum hydrocarbons in groundwater.

Aquifer conditions in the NHPAQ in the proposed Project area indicate that recharge to shallow groundwater is typically from local precipitation and surface water, and shallow groundwater generally discharges to local surface water bodies. Recharge of shallow groundwater in this area typically does not come from deeper aquifer units or from horizontal flow across long distances. Therefore, petroleum releases from the proposed Project would not be expected to affect groundwater quality within recharge areas that provide a source of groundwater to large portions of the NHPAQ or associated alluvial aquifers.

Great Plains Aquifer

Across most of the proposed pipeline area where the GPA is present, it is very unlikely that any releases from the proposed pipeline would affect groundwater quality in the aquifer because the aquifer is typically deeply buried beneath younger, water-bearing sediments and/or aquitard units.

Near the proposed pipeline area in southern Nebraska, where the aquifer is closer to the surface and contains groundwater with low salinity, the GPA is typically overlain by water-bearing sediments of the NHPAQ and alluvial aquifers. Water quality in the GPA could be affected by releases in this area, but only under conditions of a strong downward gradient in the overlying aquifer units. Although a significant downward, vertical gradient is observed between the GPA and overlying aquifers across much of Nebraska, downward gradients in the proposed pipeline area in southern Nebraska are minimal or absent. Given the expected scale, characteristics, and behavior of potential petroleum releases related to the proposed pipeline, it is very unlikely that the proposed pipeline area could affect water quality in the GPA.

Western Interior Plains Aquifer

There is extremely low probability that a release from the proposed pipeline area would affect water quality in the WIPA, given the relative typical depth of the WIPA of several hundreds of feet across the proposed Project area.

Northern Great Plains Aquifer System

After the NHPAQ and alluvial aquifers, the NGPAS represents the third most commonly used groundwater resource in the proposed pipeline area. Hydrogeologic conditions within the NGPAS are relatively complex, with several different aquifer and confining units present; however, within the proposed pipeline area, usable groundwater is typically limited to the Tertiary and Late Cretaceous formations within the aquifer group. The upward groundwater gradient across the NGPAS indicates that only those aquifer portions near the ground surface would be susceptible to water quality impacts from potential releases from the proposed pipeline area.

If a release impacts NGPAS aquifer system water quality, similar fate and transport of the petroleum products as those described for the NHPAQ and alluvial aquifers would be expected. Based on available information, the downgradient extent of groundwater impacts related to a large-scale release would typically be limited to several hundred feet of the release source, similar in scale to that expected from a large-scale release to the NHPAQ or alluvial aquifers.

Shallow aquifer conditions in the NGPAS in the proposed pipeline area indicate that recharge to shallow groundwater is typically a mixture of local precipitation and surface water and water moving upward from lower aquifers under an upward gradient; therefore, it is not expected that petroleum releases would affect groundwater within areas that provide groundwater recharge to large portions of the NGPAS.

Shallow Groundwater and Water Wells

Table 3.3-1 provides a summary of those areas where water-bearing zones are within 50 feet of the ground surface in the proposed pipeline area. These areas are typically found within alluvial aquifers along streams and rivers, within the Ogallala Formation in southern South Dakota and Nebraska, and within the overlying Nebraska Department of Environmental Quality- [NDEQ-] identified Sand Hills Unit alluvium in Nebraska. A summary of known and potential groundwater use along the proposed Project for each state is as follows:

- In Montana, a total of 326 wells are present within one mile of the proposed Project. No public water supply (PWS) wells or SWPA are located within this area. A total of six private water wells are located within approximately 100 feet of the proposed pipeline area within McCone, Dawson, Prairie, and Fallon counties.
- In South Dakota, a total of 87 wells are present within 1 mile of the proposed Project in South Dakota. One PWS well (associated with the Colome SWPA) is identified within 1 mile of the proposed pipeline in Tripp County. This PWS well is screened at a relatively shallow depth (reportedly less than 54 feet bgs) within the Tertiary Ogallala Formation. The proposed pipeline area would pass through the Colome SWPA in Tripp County. No private water wells are located within approximately 100 feet of the proposed pipeline area in South Dakota.
- In Nebraska, a total of 2,124 wells are present within 1 mile of the proposed pipeline in Nebraska. A total of 38 known PWS wells are present within 1 mile of the proposed pipeline in Boone, York, Fillmore, Saline, and Jefferson counties. The nine SWPAs within 1 mile of the proposed pipeline area include those for the towns of St. Edward, Bradshaw, York, McCool Junction, Exeter, Western, Jansen, and Steele City, and the Rock Creek State Park. The only SWPA traversed by the proposed pipeline area in Nebraska is in Steele City, Jefferson County. A total of 14 private water wells are located within approximately 100 feet of the proposed pipeline area within Antelope, Polk, York, Fillmore, and Jefferson counties.

If a potential release from the proposed pipeline would impact groundwater wells, Keystone would be required to contact the appropriate regulatory authorities and determine agency requirements for the most appropriate course of action necessary including response actions such as well abandonment, provision of alternate water supplies, and site remediation. Further, if during construction or operation activities an unregistered well is found, Keystone would provide the landowner with technical assistance to register the well.

Groundwater Extraction Effects

Construction of the Project would require use of water for activities such as dust control, directional drilling, and hydrostatic testing of the pipeline. It is likely that at least some of the water used for construction would be generated from existing groundwater resources local to the Project. Since the Project construction effort would be of relatively short duration, it is unlikely that groundwater extraction related to the Project would affect long-term water levels in any significant aquifer units along the route.

4.3.3.2 Surface Water

The proposed Project would affect waterbodies across the states of Montana, South Dakota, and Nebraska. Potential impacts to water features classified as either open water or riverine are addressed in Section 4.4, Wetlands. Pipeline construction and operational infrastructure in KS and ND would be utilized and upgraded to support the proposed Project. These locations present no unique impacts to the proposed project.

Generally speaking, the proposed Project route has been selected and modified to minimize the potential for impacts to surface water resources, as well as other sensitive environments, by avoiding them whenever possible and shifting the route to limit the area affected. There are a number of waterbodies that would be crossed by the proposed pipeline where mitigation measures would be used to reduce or minimize impacts as described in later sections. Table 4.3-1 presents a summary of potential impacts to surface water resources by state.

Table 4.3-1 Summary of Impacts to Surface Water Resources by State[a]

	Montana	South Dakota	Nebraska
Total Waterbodies Crossed	459	333	281
Perennial Waterbodies Crossed	9	16	31
Intermittent Waterbodies Crossed	424	313	237
Other Waterbodies Crossed	26	4	13
Waterbodies with State Use Classifications	15	10	40
Waterbodies with Impairments	9	5	10
Mapped Floodplains	12	4	74
Total Width of Mapped Floodplains (miles)	6.2	1.7	16.2

Source: Please refer to data tables in Section 3.3, Water Resources.

[a] The summary numbers in this table are for waterbodies and surface water resources that the proposed pipeline would cross.

Construction-Related Impacts

Construction activities could result in the following potential impacts on surface water and groundwater resources:

- Temporary increases in total suspended solids concentrations and increased sedimentation during stream crossings or at upland locations with soil erosion and transport to streams.
- Temporary to long-term changes in channel morphology and stability caused by channel and bank modifications.
- Temporary to long-term decrease in bank stability and resultant increase in total suspended solids concentrations from bank erosion as vegetation removed from banks during construction is re-establishing.

- Temporary reductions in stream flow and potential other adverse effects during hydrostatic testing activities and stream crossing construction.
- Impacts to surface water resources associated with hazardous liquids spills and leaks. See Section 4.13, Potential Releases.
- Removal of some wells within or near the right-of-way. The removal would need to be coordinated with, and approved by the owners.
- Dewatering where groundwater is less than the burial depth of the pipe (typically 4 to 7 feet) during pipe-laying activities. Dewatering through a wee system or in the excavation could generate substantial localized amounts of water to be discharged. The withdrawal and discharge would need to be permitted, monitored, and performed in a manner that has the least impact on the environment.
- Pipeline trench potentially acting as a conduit for groundwater migration and/or as a barrier to near-surface flow in areas of shallow groundwater (<7 feet bgs). While the near-surface geology is generally rather transmissive, excavating and backfilling for the pipeline may increase groundwater flow along the pipeline. Construction techniques can be employed to impede changed groundwater flow patterns. In addition, the pipe can also act as a barrier for near-surface flow down to the bottom of the pipe. Groundwater would accumulate against the pipe or more likely flow under the pipe assuming that similar geology exists all around the pipe. Impacts from these processes are believed to be minor.
- The proposed pipe in direct continuous or intermittent contact with groundwater in shallow water settings. The proposed pipeline would be designed, built, and installed using steel with protective coatings, cathodic protection, and other features to inhibit pipe degradation. Oils, grease, and other foreign materials used during manufacturing or installation would need to be removed prior to operation.
- Construction water uses, construction camp potable water, and pipeline testing related withdrawals from groundwater or surface waterbodies.

Stream Crossings and In-Stream Construction Activities

Depending on the type of stream crossing, one of six construction methods would be used: non-flowing open-cut, flowing open-cut, dry flume, dry dam-and-pump, HDD, or horizontal bore crossing. As required by the Montana Department of Environmental Quality (MDEQ) for Nationwide Permits, water must be diverted, pumped or flumed around the trench at pipeline crossings where water is present. Therefore, the non-flowing open-cut and flowing open-cut crossing methods may not meet the Section 401 requirements of the MDEQ for Nationwide Permits. For Standard Permits, separate Section 401 verification from the MDEQ would be required. Trenches through water bodies that are dry or contain non-moving water at the time of crossing would not be left open for more than 24 hours, except in extenuating circumstances, to reduce sediment discharge from a sudden storm event resulting in runoff. This commitment would not apply where excavation of rock by blasting or mechanical means may be required in the water body. More detailed descriptions of each crossing method and measures to reduce impacts associated with each method are provided in the CMRP (Appendix G) and in the Project Description (Chapter 2.0). Each stream crossing and chosen method would be shown on construction drawings, but may be amended or changed based on site-specific conditions during construction. Permitting requirement will vary based on crossing method, designated waterbody use and regulatory jurisdiction. For crossings of Section 10 navigable waters in Montana (Yellowstone and Missouri Rivers); scour depth calculations will be required to show the maximum expected depth of scour at those locations. This evaluation must include the expected depth of scour of the riverbed for a range of flows, including very high flows such as the 100-year and 500-year flows. Open-cut methods would be used at most crossings, unless deemed not feasible due to site conditions during construction or to protect sensitive waterbodies, as determined by the appropriate regulatory authority. The HDD method would be used to cross 15 major and sensitive waterbodies (see Section 3.3, Water Resources for a listing of specific crossings). The river crossing procedures and measures to reduce impacts included in the CMRP would be implemented. For waterbody crossings where HDD would be used, disturbance to the channel bed and banks would be avoided. In some instances, the pressurized fluids and drilling lubricants used in the HDD process may escape the active bore, migrate through the soils, and come to the surface at or near the construction site, an event commonly known as a frac-out. Make-up water for the drilling fluids can be extracted from local surface waterbodies, imported from more distant sources, or extracted from groundwater wells near the HDD crossing. This would be a temporary and limited use of these water resources.

There is potential for groundwater mixing between two aquifers. However, this would be minimized by the drilling fluids and muds that would seal the pipe in place. Measures identified in a contingency plan would be implemented including monitoring of the directional drill, monitoring downstream for evidence of drilling fluids, and mitigation measures to address a frac-out should one occur.

Where the HDD method is not used for major waterbody crossings or for waterbody crossings where important fisheries resources could be impacted, a site-specific plan addressing proposed additional construction and impact reduction procedures would be developed (see Appendix G, CMRP). Prior to commencing any stream-crossing construction activities, at a minimum, permits would be required under Section 404 of the Clean Water Act through the U.S. Army Corps of Engineers (USACE), and Section 401 Water Quality Certification, per state regulations. These agencies could require measures to limit unnecessary impacts such as requiring all the non-HDD crossings to be constructed during dry conditions.

In order to minimize HDD impacts, the U.S. Department of the Interior (DOI) has specific requirements, recommendations, and comments related HDD activities used to cross above National Wild and Scenic River segments or tributary rivers and streams of a designated river and the associated floodplain areas (DOI 2012).

Construction activities for open-cut wet crossings involve excavation of the channel and banks. Construction equipment and excavated soils would be in direct contact with surface water flow. The degree of impact from construction activities would depend on flow conditions, stream channel conditions, and sediment characteristics. For the types of crossings listed below, the following measures would be implemented on a site-specific basis:

- Contaminated or Impaired Waters—If required, specific crossing and sediment handling procedures would be developed with the appropriate regulatory agencies, and agency consultation and recommendations would be documented and implemented.
- Sensitive/Protected Waterbodies—If required, specific construction and crossing methods would be developed in conjunction with USACE and U.S. Fish and Wildlife Service

consultation. The appropriate method of crossing these waterbodies would be determined by the USACE or U.S. Fish and Wildlife Service, as applicable.

- HDD Crossings—A frac-out contingency plan would be developed in consultation with the regulatory agencies to address appropriate response and crossing implementation in the event of a frac-out during HDD crossings. Implementation of measures as described in the proposed Project CMRP (Appendix G) and additional conditions from permitting agencies would reduce adverse impacts resulting from open-cut wet crossings. All contractors would be required to follow the identified procedures to limit erosion and other land disturbances. The CMRP describes the use of buffer strips, drainage diversion structures, sediment barrier installations, and clearing limits, as well as procedures for waterbody restoration at crossings. (See Chapter 2.0 and the CMRP for a discussion of the proposed waterbody crossing methods.)

For construction access, temporary bridges, including subsoil fill over culverts, timber mats supported by flumes, railcar flatbeds, and flexi-float apparatus would be installed across waterbodies. These temporary crossings would be designed and located to minimize damage to stream banks and adjacent lands. The use of temporary crossings would reduce the impacts to the waterbodies by providing access for equipment to specific locations. These crossings would be designed and constructed to provide unimpeded fish and aquatic organism passage during the timeframe the crossing is in place.

Following completion of waterbody crossings, waterbody banks would be restored to preconstruction contours, or at least to a stable slope. Stream banks would be seeded for stabilization, and mulched or covered with erosion control fabric in accordance with the CMRP and applicable state and federal permit conditions. Additional erosion control measures would be installed as specified in any permit requirements. However, erosion control measures can themselves cause adverse environmental impacts. For example, placement of rock along the bank at a crossing could induce bank failure further downstream.

The pipeline would be installed at the design crossing depth for at least 15 feet beyond the design lateral migration zone, with design width and depths determined by qualified personnel. The depth of burial at waterbodies, ditches, drainages, and other similar features would be 60 inches, except in rocky areas where the minimum burial depth would be 36 to 48 inches. Where major waterbodies are crossed using the HDD method, the depth from the streambed to the top of the pipe would be substantively greater than 60 inches. The design of the crossings also would include the specification of appropriate stabilization and restoration measures. Permits required under Sections 401 and 404 of the Clean Water Act would include additional site-specific conditions as determined by USACE and appropriate state regulatory authorities.

The National Hydrography Dataset (U.S. Geological Survey [USGS] 2012) indicates that three proposed pump stations (Pump Station 9 in Phillips County, Montana, Pump Station 10 in Valley County, Montana, and Pump Station 20 in Tripp County, South Dakota) would be constructed over unnamed intermittent streams. However, field surveys indicated Pump Station 9 is located in tilled crop land and was not in an intermittent stream. Further, as the location and design for Pump Station 24 in Nebraska is finalized, Keystone will develop an access plan for this pump station given its location near the Loup River that takes into account access issues during flood conditions.

Hydrostatic Testing and Water Withdrawals

Water hydrostatic testing is performed to expose defective materials or welds that have missed prior detection, expose possible leaks, and serve as a final validation of the integrity of the constructed system. A hydrostatic test is conducted on individual segments of pipeline prior to completion. Buried high-pressure oil pipelines are tested for strength by pressurizing them to at least 125 percent of their maximum operating pressure at any point along their length with water drawn from local water sources. Water used for hydrostatic testing would be obtained from nearby surface water resources, groundwater, or municipal sources. These sources include streams, rivers, privately owned reservoirs, and private or public wells.

Table 4.3-2 lists the surface water bodies which may be considered for potential hydrostatic test water sources along the project route as provided by Keystone. The proposed Project CMRP Section 8 (Appendix G) specifies the applicant's committed actions for securing pipeline hydrostatic test water. The Federal Energy Regulatory Commission (FERC) has developed criteria for the minimum separation distance for hydrostatic test manifolds from wetlands and riparian areas appropriate for natural-gas-pipeline construction. Although the proposed Project is not subject to FERC authority, hydrostatic test manifolds would be located more than 100 feet away from wetlands and riparian areas to the maximum extent possible, consistent with FERC requirements.

Table 4.3-2 Potential Hydrostatic Test Water Sources along the Project Route[a, b, c, d]

County	Approximate Milepost	Waterbody Name	Maximum Water Withdrawal (million gallons)
Montana			
Phillips	25.4	Frenchman Creek	32
Valley	83.4	Milk River	32
Valley/McCone	89.2 to 89.3	Missouri River	55
Dawson	196.4	Yellowstone River	55
South Dakota			
Harding	295.1	Little Missouri River	27
Harding	315	Gardner Lake	67
Perkins	360.97	North Fork Moreau River	36
Meade	429.9	Cheyenne River	35
Haakon	486	Bad River	22
Tripp	541.3	White River	39
Nebraska[e]			
Boyd	618.1	Keya Paha River	37
Holt	626.1	Niobrara River	37
Antelope	713.3	Elk Horn River	37

County	Approximate Milepost	Waterbody Name	Maximum Water Withdrawal (million gallons)
Nance	761.7	Loup River	37
Polk	775.2	Platte river	47

[a] These volumes are estimated at this time. Final volumes will be included in appropriate water use permits for each state. At that time, the state permitting agency will determine which rivers can be used, if they approve the volume, and any permitting conditions associated with the withdrawals. Water will be used for hydrostatic test water, drilling mud for HDD operations, and dust control.
[b] Additional water sources will be needed for dust control. These additional sources will require lower volumes (up to 6 million gallons on average). Dust control sources would be permitted in accordance with state permit requirements and could include existing irrigation wells.
[c] Ground water sources (irrigation wells) may be used for water sources instead of the rivers listed below. These water sources and the volumes to be used would be purchased from landowners and would be permitted in accordance with state requirements.
[d] These water volumes would be required for both years of construction.
[e] Additional water would be withdrawn from irrigation wells in several counties crossed by the project for approximately 55,000,000 gallons of water for dust control, hydrostatic testing, and HDD operations.

In an effort to avoid or minimize impacts to sensitive waterbodies, detailed consultation with the USFWS and Natural Resource Conservation Service (NRCS) would be done during the permitting phases when planning stream crossings in already depleted and drought prone watersheds.

During droughts, surface water withdrawal permits from larger rivers with existing water rights would be regulated by state regulatory agencies to preserve existing water rights and environmental requirements. If inadequate water is available from rivers, Keystone would use alternative water sources nearby such as local private wells or municipal sources for HDD operations, hydrostatic testing the mainline, and dust control during these dry conditions. Keystone has indicated that in the event surface water is unavailable, groundwater would be used for HDD operations, hydrostatic testing, and dust control. Water would be purchased from nearby willing sellers with available water rights and would not increase overall groundwater use.

The U.S. Fish and Wildlife Service (USFWS) has expressed concerns about any water withdrawals from the Platte River. They were requested to provide informal Section 7 consultation and technical assistance for the Project. In their response letter dated September 4, 2012 (FWS NE: 2013-013) from Michael D. George to K. Nicole Gibson, Ph.D., they state: "Since 1978, the USFWS has concluded in all of its Section 7 consultations on water projects in the Platte River basin that the Platte River ecosystem is in a state of jeopardy, and any federal action resulting in a water depletion to the Platte River System will further or continue the deterioration of the stressed habitat conditions." They go on the say that any depletion of flows, either direct or indirect, from the Platte River System would be considered significant and they consider the river and associated wetland habitats to be "resources of national and international importance." To mitigate any impacts to the Platte River ecosystem, Keystone would coordinate with the USFWS before any water withdrawals.

Withdrawals from impaired or contaminated waterbodies would be avoided and only used if approved as a water source. All surface water resources used for hydrostatic testing would be approved by the appropriate permitting agencies prior to initiation of any testing activities. Planned withdrawal rates for each water resource would be evaluated and approved by these agencies prior to testing. No resource would be used for hydrostatic testing without receipt of applicable permits. As stated in the proposed Project CMRP Section 8.2 (Appendix G), required water analyses would be obtained prior to obtaining any water for filling or any discharging operations associated with hydrostatic testing.

The water withdrawal methods described in the proposed Project CMRP would be implemented and followed. These procedures include screening of intake hoses to prevent the entrainment of fish or debris, keeping the hose at least 1 foot off the bottom of the water resource, prohibiting the addition of chemicals into the hydrostatic test water, and avoiding discharging any hydrostatic test water that contains visible oil or sheen (from pipe or equipment) following testing activities. As a standard procedure and as part of its water withdrawal and discharge permits, Keystone would identify water rights that could be affected by temporary interruptions of water flow. Keystone would also abide by mitigation measures outlined in applicable water withdrawal and discharge permits to protect sensitive receptors, such as fisheries.

Hydrostatic test water would be discharged at an approved location along the waterway/wetland or to an upland area within the same drainage as the source water where it may evaporate or infiltrate. Discharged water would be tested for water quality prior to release in the environment to ensure it meets applicable water quality standards imposed by the discharge permits for the permitted discharge locations. Where hydrostatic test water does not meet standards for discharge proper, treatment or disposal is required. The proposed Project CMRP incorporates additional measures designed to minimize the impact of hydrostatic test water discharge, including regulation of discharge rate, the use of energy dissipation devices, channel lining, and installation of sediment barriers as necessary.

4.3.3.3 Operational-Related Impacts

Surface water impacts associated with potential crude oil releases from pipeline operation are addressed in Section 4.13, Potential Releases.

Channel migration or streambed degradation could potentially expose the pipeline, resulting in temporary, short-term, or long-term adverse impacts to water resources; however, protective activities such as reburial or bank armoring would be implemented to reduce these impacts. As described in the proposed Project CMRP (Appendix G), a minimum depth of cover of 5 feet below the bottom of all waterbodies would be maintained for a distance of at least 15 feet to either side of the edge of the waterbody. General channel incision or localized headcutting could threaten to expose the pipeline during operations. In addition, channel incision could sufficiently increase bank heights to destabilize the slope, ultimately widening the stream. Sedimentation within a channel could also trigger lateral bank erosion, such as the expansion of a channel meander opposite a point bar. Bank erosion rates could exceed several meters per year. Not maintaining an adequate burial depth for pipelines in a zone that extends at least 15 feet (5 meters) beyond either side of the active stream channel may necessitate bank protection measures that would increase both maintenance costs and environmental impacts. Potential bank protection measures could include installing rock, wood, or other materials keyed into the bank to provide protection from further erosion, or regrading the banks to reduce the bank slope. Disturbance associated with these maintenance activities may potentially create additional water quality impacts.

All waterbody crossings would be assessed by qualified personnel in the design phase of the proposed Project with respect to the potential for channel aggradation/degradation and lateral channel migration. The level of assessment for each crossing could vary based on the professional judgment of the qualified design personnel. The proposed pipeline would be installed as determined to be necessary to address any hazards identified by the assessment. The pipeline would be installed at the design crossing depth for at least 15 feet beyond the design lateral migration zone as determined by qualified personnel. The design of the crossings would also include the specification of appropriate stabilization and restoration measures.

Operational impacts to surface water resources associated with hazardous liquids spills and leaks are discussed in Section 3.13 and 4.13, Potential Releases.

The measures to protect water resources during operations are specified in the CMRP, (Appendix G). In South Dakota, the water protection conditions that were developed by the South Dakota Public Utility Commission as part of its Amended Final Decision and Order (Notice of Entry HP09-001) would be implemented.

4.3.3.4 Floodplains

The proposed pipeline would cross mapped and unmapped floodplains in Montana, South Dakota, and Nebraska. The proposed pipeline would be constructed under many river channels with potential for vertical and lateral scour. In floodplain areas adjacent to waterbodies, the contours would be restored to as close to previously existing contours as practical and the disturbed area would be revegetated during construction in accordance with the CMRP (Appendix G). Therefore, after construction, the proposed pipeline would not obstruct flows over designated floodplains, resulting in only minor changes to topography, and thus would not affect local flood dynamics or flood elevations.

Ancillary features, such as pump stations, mainline valves, and access roads in mapped and unmapped floodplain areas would be assessed prior to permitting and designed to minimize impacts to floodplains. These facilities would be constructed after consultation with the appropriate county agencies to ensure the design meets county requirements and to obtain the necessary permits associated with construction in the 100-year floodplain zones. Table 4.3-3 shows the infrastructure in mapped floodplains.

Table 4.3-3 Ancillary Facilities Crossing Designated Floodplain Areas for the Proposed Pipeline Route

State	County	Approximate Project ROW Milepost[a]	Waterbody Associated with Floodplain[b,]	Facility Type[c]	ID (or HDD #)	ID	ID
MT	Valley	59.89 - 59.91	Spring Creek	Access Roads	CAR-084	CAR-225	
MT	Valley	61.74 - 61.75	Morgan Creek	Transmission Line	PS 10		
MT	Valley	65.90 - 66.20	Cherry Creek	Transmission Line	PS 10		
MT	Valley	71.70 - 71.90	East Fork Cherry Creek	Transmission Line	PS 10		
MT	Valley	83.20 - 85.50	Milk River	Access Roads	CAR-120	CAR-122	CAR-123
				Transmission Line	PS 10		
MT	Valley & McCone	89.10 - 90.70	Missouri River	Access Roads	CAR-124	CAR-125	
				HDD portals	2		
MT	McCone	148.23 - 148.78	Redwater River	Transmission Line	PS-12		

State	County	Approximate Project ROW Milepost[a]	Waterbody Associated with Floodplain[b]	Facility Type[c]	ID (or HDD #)	ID	ID
MT	Dawson	197.24 - 198.17	Yellowstone River	Access Roads	CAR-127	CAR-292	
				HDD portal	1		
				Valve	MLV-10		
				Other	PY-07 SITE 4		
SD	Harding	294.8 - 295.0	Little Missouri River	HDD portal	1		
				Transmission Line	PS 15		
SD	Haakon	485.9 - 486.0	Bad River	Transmission Line	PS 19		
SD	Lyman & Tripp	541.0 - 541.7	White River	Access Roads	CAR-080	CAR-237	
				HDD portal	1		
NE	Boyd	617.85 - 618.18	Meglin Cr	Access Road	CAR-306		
NE	Boyd	617.85 - 618.18	Unnamed Tributary to Keya Paha River	Access Road	CAR-306		
NE	Boyd	617.85 - 618.18	Keya Paha River	Access Road	CAR-307		
				HDD portal	1		
NE	Boyd	625.81 - 626.09	Niobrara	HDD portal	1		
NE	Antelope	712.77 - 713.52	Elkhorn River	Access Roads	CAR-253	CAR-286	
				HDD portal	1		
NE	Nance	761.13 - 762.36	Loup River	Access Roads	CAR-264	CAR-268	
				HDD portals	2		
NE	Polk	775.09 - 775.68	Platte River	HDD portal	1		
NE	York	801.12 - 801.8	Unnamed Tributary to Beaver Creek	Access Road	CAR-274	CAR-218	
NE	Saline	838.35 - 838.40	Unnamed Tributary to North Fork Swan Creek	Access Road	CAR-280		

[a] Ancillary facilities floodplain crossings are listed by the Project Milepost numbers and are not necessarily adjacent to the project ROW at that milepost.
[b] Ancillary facilities may cross unmapped floodplain areas.
[c] Additional ancillary facility floodplain crossings may be incurred when final route adjustments are made.

4.3.4 Recommended Additional Mitigation

The following mitigation measures are recommended in addition to those proposed or planned by the applicant:

- Taking into account the concerns expressed by U.S. Environmental Protection Agency (USEPA) and other commenters on the prior National Environmental Policy Act documents for this project, the Department in consultation with the Pipeline Hazardous Materials Safety

Administration (PHMSA) and USEPA, determined that it may be appropriate for the applicant to commission an additional engineering risk analysis of the efficacy of installing external leak detection in areas of particular environmental sensitivity. The Department in consultation with PHMSA and USEPA determined that Keystone should commission an engineering analysis by an independent consultant that would review the proposed Project risk assessment and proposed valve placement. The engineering analysis would, at a minimum, assess the advisability of additional valves and/or the deployment of external leak detection systems in areas of particularly sensitive environmental resources. This analysis was begun but not completed because the previous application was denied in January 2012. If Nebraska approves a route through the state the report would be completed taking into account that approved route. After completion and review of the engineering analysis, the Department with concurrence from PHMSA and USEPA would determine the need for any additional mitigation measures.

- USEPA and other previous commenters have recommended consideration of ground-level inspections as an additional method to detect leaks. The PHMSA report (2007) on leak detection presented to Congress noted that there are limitations to visual leak detection, whether the visual inspection is done aerially or at ground-level. A limitation of ground-level visual inspections as a method of leak detection is that pipeline leaks may not come to the surface on the right-of-way (ROW) and patrolling at ground level may not provide an adequate view of the surrounding terrain. A leak detection study prepared for the Pipeline Safety Trust noted: “A prudent monitor of a pipeline ROW will look for secondary signs of releases such as vegetation discoloration or oil sheens on nearby land and waterways on and off the ROW” (Accufacts 2007). PHMSA technical staff concurred with this general statement, and noted that aerial inspections can provide a more complete view of the surrounding area that may actually enhance detection capabilities. Also, Keystone responded to a data request from the Department concerning additional ground-level inspections and expressed concerns that frequent ground-level inspection may not be acceptable to landowners because of the potential disruption of normal land use activities (e.g., farming, animal grazing). PHMSA technical staff indicated that such concerns about landowner acceptance of more frequent ground-level inspections were consistent with their experience with managing pipelines in the region. Although widespread use of ground-level inspections may not be warranted, in the start-up year it is not uncommon for pipelines to experience a higher frequency of spills from valves, fittings, and seals. Such incidences are often related to improper installation, or defects in materials. In light of this fact, the Department, in consultation with PHMSA and USEPA, determined that if the proposed Project were permitted, it would be advisable for the applicant to conduct ground inspections of all intermediate valves, and unmanned pump stations during the first year of operation to facilitate identification of small leaks or potential failures in fittings and seals. It should be noted however, that the 14 leaks from fittings and seals that have occurred to date on the existing Keystone Oil Pipeline were identified from the Supervisory Control and Data Acquisition leak detection system and landowner reports. Keystone has agreed to incorporate into its operations and maintenance plan a requirement to conduct ground inspections of all intermediate valves, and unmanned pump stations during the first year of operation to facilitate identification of small leaks or potential failures in fittings and seals.

- Dust suppression chemicals should not be used within or adjacent to sensitive regions. Many of these chemicals are salts of various formulations. Any advanced dust suppression techniques (beyond the use of watering) should be protective of the high water quality present in this area. Overuse can cause potential localized degradation of groundwater quality where groundwater is near the surface. Usage should be proactively managed and monitored. Part 2.14 of the Revised CMRP mentions the use of calcium chloride. The use of misting dust suppression systems should be used within sensitive areas to eliminate the need for salt compounds NDEQ. This approach will be revised for the Final SEIS based on updated NDEQ requirements for sensitive areas as necessary.
- This project could require authorization under the NDEQ National Pollutant Discharge Elimination System Construction Storm Water General Permit. Conditions of this permit may require modifications to the stabilization of disturbed ground as discussed within the CMRP. Namely, the Construction Storm Water General Permit requires that ground which will be inactive for 14 days be stabilized (either permanent or temporary stabilization), assuming NPDES permit conditions would supersede any state-level regulation that is less stringent.
- An assessment of the streambed and bank forms at waterbody crossings would be done during the permitting and design phase; adding this analysis should provide significant cost savings and environmental benefits. The implementation of appropriate measures to protect pipeline crossings from channel incision and channel migration can reduce the likelihood of washout-related emergencies, reduce maintenance frequency, limit adverse environmental impacts, and in some cases improve stream conditions. Therefore, waterbody crossings would be assessed by qualified personnel in the design phase of the proposed Project with respect to the potential for channel aggradation/degradation and lateral channel migration. The level of assessment for each crossing could vary based on the professional judgment of the qualified design personnel. The proposed pipeline would be installed as necessary to address any hazards identified by the assessment.
- For any waterbody crossings that utilize HDD or any other bore method, it is recommended that the bore entrance and exit points be located entirely outside of the channel migration zone (CMZ), and that the pipeline be constructed sufficiently below the maximum design scour depth for the entire CMZ width to prevent unexpected pipeline exposure during channel migration events. In addition, other permanent features such as access roads or construction pads should also be placed outside the areal extent of the 100-year CMZ. Many of the rivers in the proposed Project ROW are unstable with high sediment supply systems with dynamic active channel(s), depositional bars and active bank margins. Some of the larger rivers crossed by the proposed Project, such as the Yellowstone and Missouri Rivers in Montana; or the Platte River, Loup River, and Prairie Creek in Nebraska, are all drainage systems capable of substantial lateral channel migration, bank retreat, and subsequent re-activation of historic floodplains and channels during the life of the proposed Project. All states affected by the proposed Project are prone to ice jams on their major rivers, which often cause substantial backwatering and lateral scour. CMZs are defined by the corridor that each river is expected to occupy over a given timeframe and are based on physical geomorphic parameters and local geologic control. As an example, CMZs for the Yellowstone River in Montana have been mapped (Yellowstone River Conservation District Council 2009) as part of an effort by state and federal agencies to provide additional

information for minimizing impacts to major surface water and natural resources, including avoidance of poor development decisions and subsequent damage or loss of infrastructure and property.

- Culvert design and construction should be done to ensure unimpeded fish and aquatic organism passage during the lifetime of the proposed Project for all road-stream crossings over fish-bearing streams. There are many recent and reliable engineering manuals that provide methods for designing and constructing fish friendly road-stream crossings. These methods should be followed when road-stream crossings on fish bearing streams are required and should be incorporated into the CMRP (Appendix G).
- Construction camps built along the proposed pipeline route, construction activities and pipeline testing would use water from surface waterbodies, imported water, or groundwater from a local well. Water would be used for drinking, dust suppression, vehicle washing, and other uses. Water withdrawal from surface waterbodies or wells would need to be permitted and approved by various agencies and water rights owners. There are currently four construction camps planned for Montana, three construction camps planned for South Dakota, and one camp slated for Nebraska. Waterbodies with habitats and species sensitive to or potentially impacted by flow reductions should be thoroughly analyzed to prevent adverse effects.

4.3.5 Connected Actions

4.3.5.1 Bakken Marketlink Project

Groundwater

No significant large-scale potable water aquifers underlie the Bakken Marketlink Project area, although alluvium is likely present that contains potable groundwater. The Upper Cretaceous Hells Creek/Fox Hills Aquifer of the NGPAS underlies the area, but water quality in this area of the aquifer is relatively saline. Larger potable water aquifers within recent alluvium are present within several miles to the east and west of the Bakken Marketlink Project area, and Lower Tertiary rocks of the NGPAS containing potable water are present within a few miles west of the western terminus of the Bakken Marketlink Project area (Whitehead 1996, LaRocque 1966). Well depths are also typically greater than 50 feet. Because of the limited amount of potable water directly beneath the Bakken Marketlink Project area and the significant depth to groundwater in this area, it is not likely that releases would significantly impact groundwater resources in the area.

Surface Water

Construction and operation of the Bakken Marketlink Project would include metering systems and three new storage tanks near Baker, Montana and two storage tanks in Cushing, Oklahoma. Based on a GIS analysis of the planned route and intersections with waterbodies identified in the 2012 NHD, there would be a total of 8 waterbodies crossed in Montana. Of the total, Sandstone Creek is the only waterbody classified as perennial; 7 waterbodies are intermittent.

The property proposed for the Bakken Marketlink Project facilities near Pump Station 14 is currently used as pastureland and hayfields and a site inspection of the property indicated that there were no waterbodies or wetlands on the property. As a result, the potential impacts associated with expansion of the pump station site to include the Bakken Marketlink Project facilities would likely be similar to those described above for the proposed Project pump station and pipeline ROW in that area. The construction and operation of the Bakken Marketlink Project would have negligible effects on water resources. Any impacts associated with the Bakken Marketlink Project would be similar in scope and duration to the proposed Project.

4.3.5.2 Big Bend to Witten 230-kV Transmission Line

Groundwater

Groundwater along the alignment of the Big Bend to Witten 230-kilovolt (kV) Transmission Line is present primarily in recent alluvium of the White and Missouri Rivers and in Quaternary glacial deposits near the Missouri River. Groundwater is typically present at depths of less than 50 feet bgs in these unconsolidated deposits. The deposits overlie the Cretaceous Pierre Shale, which is a regional aquitard. Water-bearing units of the GPA and WIPA beneath the Pierre Shale are typically saline and not used for drinking water or irrigation purposes.

Potential impacts to groundwater resources related to the installation and operation of the Big Bend to Witten 230-kV Transmission Line are expected to be limited to small-scale petroleum product releases related to vehicle operations and fueling. Hydrogeologic conditions and fate and transport of releases would be similar to conditions described for alluvial aquifers in the proposed pipeline area.

Surface Water

The Big Bend to Witten 230-kV electrical transmission line would cross three perennial streams along the preferred route (Appendix J, Basin Electric Big Bend to Witten 230-kV Transmission Project Routing Report). Potential impacts to crossings of surface water resources would be minimized by spanning them entirely. Project construction would use an typical span length between 650 and 950 feet. The largest perennial stream crossed is the White River which has a maximum waterbody width of 570 feet.

In addition, the transmission line would run parallel to and within 100 feet of perennial and intermittent streams for a cumulative distance of 28,000 feet. An adequate buffer between the transmission line corridor and adjacent surface waters would be needed to minimize continued impacts to surface water features during initial construction and long-term operation and maintenance activities.

4.3.5.3 Electrical Distribution Lines and Substations

Groundwater

Potential impacts to groundwater resources related to the installation and operation of electrical transmission lines associated with the proposed pipeline area are expected to be limited to small-scale petroleum product releases related to vehicle operations and fueling. Hydrogeologic conditions and fate and transport of releases would be similar to conditions described for the proposed pipeline area adjacent to the planned transmission lines.

Surface Water

The proposed Project would require electrical service from local power providers for pump stations and other aboveground facilities in Montana, South Dakota, Nebraska, and Kansas.

Based on a GIS analysis of the planned locations for electrical lines and substations and intersections with waterbodies identified in the 2012 NHD, there would be a total of 217 waterbodies crossed in Montana. Of the total, Duck Creek is the only waterbody classified as perennial; 192 waterbodies are intermittent, 13 are canals/ditches, and 12 are unidentified waterbodies. Using the same GIS comparison, there would be a total of 250 waterbodies crossed in South Dakota. Of the total, 16 are perennial, 218 are intermittent, and 16 are unidentified waterbodies. In Nebraska, there would be an approximate total of 281 waterbodies crossed. These include 31 perennial, 237 intermittent, and 13 unidentified waterbodies. Additional relevant information regarding the distribution lines in Kansas is pending and will be included in this review as part of the Final Supplemental EIS.

There is no information provided regarding the locations of poles or other on-the-ground features associated with this connected action that could impact the waterbodies identified above; however, effects on surface waters are expected to be limited based on permitting requirements and generally accepted practices used during the construction of distribution lines. These lines typically span surface water bodies, equipment crossings are likely to use existing access or temporary crossings, and standard construction erosion controls are employed to limit sedimentation, similar to methods that would be used for the proposed pipeline. Poles placed in effective and designated floodplain areas have the potential to snag and collect debris being conveyed by flood water. This debris should be cleared from poles following flood subsidence. Obstructions in the floodplain have the potential to induce scour and sedimentation, however based on typical sizing and spacing of poles the affects to the environment are considered negligible.

4.3.6 References

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